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Short communication

The role of domestic dogs and cats in the zoonotic cycles of ticks and pathogens. Preliminary studies in the Wrocław Agglomeration (SW Poland)

Nina Król[a,*], Dorota Kiewra[a], Mariusz Szymanowski[b], Elżbieta Lonc[a]

[a] Department of Microbial Ecology and Environmental Protection, Institute of Genetics and Microbiology, University of Wrocław, Przybyszewskiego 63/77, 51-148 Wrocław, Poland
[b] Department of Geoinformatics and Cartography, Institute of Geography and Regional Development, University of Wrocław, pl. Uniwersytecki 1, 50-137 Wrocław, Poland

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ABSTRACT

The collection of 729 tick specimens (*Ixodes ricinus*, 88.6%; *Ixodes hexagonus*, 9.2%; *Dermacentor reticulatus,* 2.2%) removed from 373 dogs and 78 cats, along with 201 ticks from vegetation (*I. ricinus*, 75.6%; *D. reticulatus,* 24.4%), allows one to say that pets play an important role in maintaining tick life cycles in different urban area. It shows the lack of statistical differences between tick intensity in high-impact anthropogenic areas (HIAA), low-impact anthropogenic areas (LIAA) and mixed areas designed, in an objective way, by GIS techniques.

The comparable (statistically insignificant) level of infection with *Borrelia* spp. of *I. ricinus* from pets (22.5%) and vegetation (24.8%), shows that dogs and cats do not have zooprophylactic competence for *Borrelia* spp. in different urban areas. Moreover, *Borrelia* spp. was detected in *I. hexagonues* (1.5%) collected from pets, and in *D. reticulatus* (2%) obtained from vegetation. The presence of *D. reticulatus* in the Wrocław Agglomeration confirms its expansion and the distribution range in Poland.

1. Introduction

Lyme borreliosis (LB) caused by *Borrelia burgdorferi* s.l. is, to date, still considered to be the most significant bacterial tick-borne disease (TBD) in the northern hemisphere (Bowman and Nuttall, 2009). In Europe, including Poland, LB is mainly transmitted by *Ixodes ricinus* L., the castor bean tick (Nowak-Chmura and Siuda, 2012). The average infection rate of *B. burgdorferi* in Europe, as in Poland, is higher in adult ticks than in nymphs (Rauter and Hartung, 2005; Kiewra, 2014). A non-specific, three host *I. ricinus,* can parasitize several hundreds of vertebrate species (Anderson, 1991, according to Bowman and Nuttall, 2009). Most of the tick hosts are not reservoir species, according to the criteria listed by Gern et al. (1998), and their role in pathogen circulation is linked only to amplifying circulation of vectors (amplifier hosts). In reservoirs, which are the primary source of infection for vectors and play significant role in the circulation of pathogen, active bacteremia leads to general infection which persists for a considerable time; therefore, the transfer of pathogens to tick vector is easier (Michalik and Zajkowska, 2013). On the other hand, some host species can play the zooprophilactic role for *B. burgdorferi* s.l. and they contribute to magnify the dilution effect (Kjelland et al., 2011; Mannelli et al., 2012). In recent times, cases of tick-borne diseases have not only been noted in rural areas, they have also been identified in urban settings (Kiewra, 2014; Rizzoli et al., 2014). The increased morbidity of LB among inhabitants who declare contact with ticks only in city areas shows that borreliosis is also a threat in anthropogenic areas. In cities, the important hosts of *I. ricinus* are wild animals, e.g., rodents and hedgehogs, as well as newly observed foxes and wild boars; however, the role of pets should be also taken into account (Hamer et al., 2009; Rizzoli et al., 2014). In Poland, dogs and cats can be parasitized by 5

from 19 recognized tick species (Nowak-Chmura and Siuda, 2012). *I. ricinus* and *Dermacentor reticulatus* are the species of ticks most commonly collected from pets (Siuda et al., 2002; Zygner and Wędrychowicz, 2006; Michalski and Sokół, 2013). They are proven

* Corresponding author.
E-mail address: nina.krol@uni.wroc.pl (N. Król).

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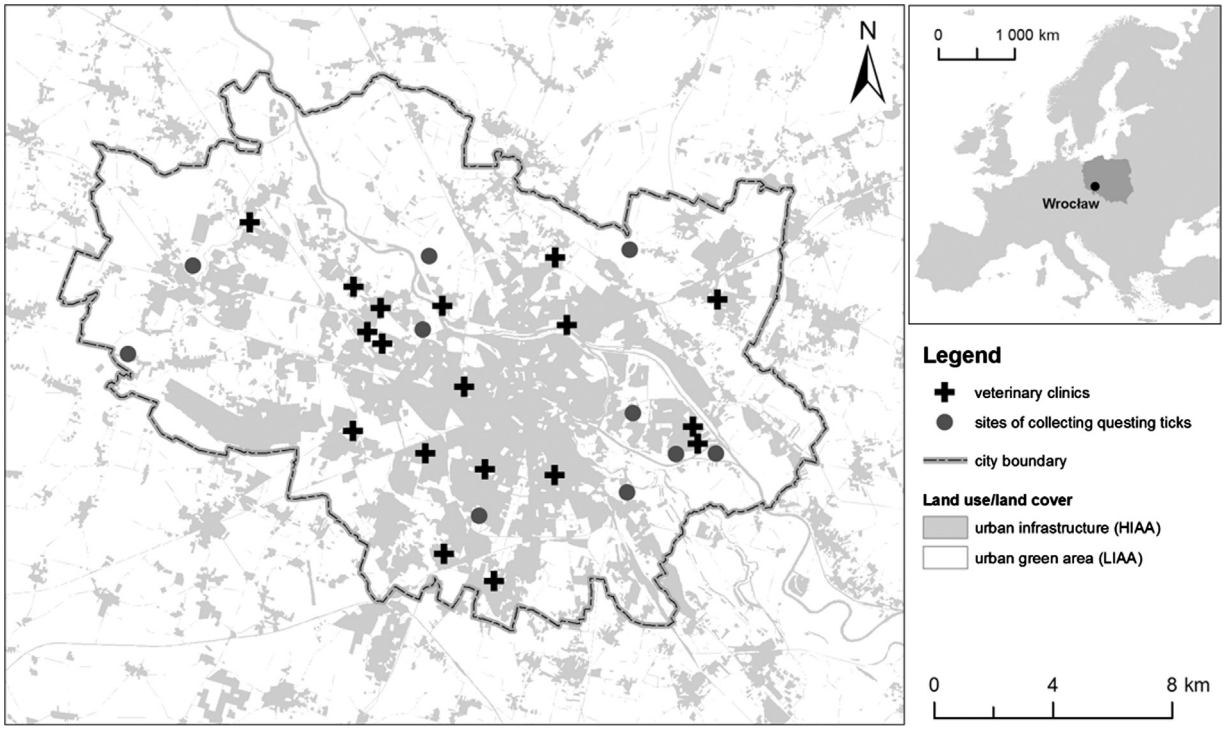

Fig. 1. The location of 18 veterinary clinics and sampling sites of ticks in the Wrocław Agglomeration (Poland), 2013.

to be important vectors of several pathogens, such as *B. burgdorferi* s.l., *Anaplasma phagocytophilum* and *Babesia* spp. (Skotarczak, 2006; Zygner et al., 2008, 2010; Lonc et al., 2011). Additionally, *Ixodes hexagonus*, *Ixodes crenulatus* and *Ixodes rugicollis* can feed on domestic pets. *Rhipicephalus sanguineus* has only coincidentally been noted in Poland as an adventive species (Nowak-Chmura and Siuda, 2012). The main purpose of the paper was to estimate the role of pets (cats and dogs) in the circulation of ticks as vectors of *Borrelia* spp. in the anthropogenic differentiated urban area in the Wroclaw Agglomeration, Poland, with particular attention paid to areas designed by GIS techniques: urban and semi-natural land cover in the city area.

2. Material and methods

2.1. Tick collection

In 2013 ticks were collected from dogs and cats in the veterinary clinics, as well as from vegetation in the Wrocław Agglomeration, Poland (Fig. 1). Wrocław (ca. 292.8 km^2, population of approx. 631,200) is located in the south–west of Poland (51°07′ N, 17°02′ E) in the Silesian Lowland. In Wrocław, the number of dogs is approximately 100,000 (Statistical Yearbook of the City of Wrocław, 2012).

In total, 18 veterinary clinics submitted 729 ticks found on 451 domestic dogs and cats. The questing ticks from vegetation (n = 201) were collected from April to October; this took place once a month, by the flagging method (by one person for one hour), in ten urban locations. Tick specimens were determined by life stage, sex and species (Nowak-Chmura, 2013). The owners of infested animals were asked to fill in a short survey about pet-walking areas which could then be identified as potential urban tick habitats.

2.2. Spatial and statistical analysis

GIS tools and methods were used to recognize the influence of anthropogenic pressure on host-parasite habitats. They were characterized by different land use/land cover (LULC) classes. The Urban Atlas provided by the European Environmental Agency (http://www.eea.europa.eu/data-and-maps/data/urban-atlas) was used as the proper, fine-resolution LULC database for the purpose of the study (Prastacos et al., 2011). The database was initially processed and qualitatively generalized by grouping all LULC categories into two main classes with potentially different anthropogenic and natural impacts:

- low-impact anthropogenic areas (LIAA) which can be considered as wildlife/ecological corridors. These areas were formed by

Table 1
Ticks collected from dogs and cats and from vegetation in the Wrocław Agglomeration (Poland), 2013.

Species	Number (%) of tick stages																	
	Females			Males			Nymphs			Larvae			Total	Females	Males	Nymphs	Larvae	Total
	Collected from hosts													Collected from vegetation				
	Total	Cats	Dogs	Total	Cats	Dogs	Total	Cats	Dogs	Total	Cats	Dogs						
Dermacentorreticulatus	11 (68.7)	1	10	5 (31.3)	–	5	–	–	–	–	–	–	16 (100)	35 (71.4)	14 (28.6)	–	–	49 (100)
Ixodes hexagonus	22 (32.8)	5	17	–	–	–	43 (64.2)	5	38	2 (3.0)	–	2	67 (100)	–	–	–	–	–
Ixodes ricinus	584 (90.4)	138	446	59 (9.1)	18	41	3 (0.5)	–	3	–	–	–	646 (100)	60 (39.5)	44 (28.9)	48 (31.6)	–	152 (100)
Total	617 (84.6)	144	473	64 (8.8)	18	46	46 (6.3)	5	41	2 (0.3)	–	2	729 (100)	95 (47.2)	58 (28.9)	48 (23.9)	–	201 (100)